IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
BRUNA ET AL.

Serial No. **Not Yet Assigned**

Filing Date: **Herewith**

For: **A METHOD OF COMPRESSING DIGITAL IMAGES**

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DATE OF DEPOSIT: July 9, 2001

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SIGNATURE: Alex Greene

PRELIMINARY AMENDMENT

Director, U.S. Patent and Trademark Office
Washington, D.C. 20231

Sir:

Prior to the calculation of fees and examination of the present application, please enter the amendments and remarks set out below.

In the Claims:

Please cancel Claims 1 to 11.

Please add new Claims 12 to 41.

12. A method for compressing a digital image comprising a matrix of elements, each element comprising at least one digital component for representing a pixel, the method comprising:

splitting the digital image into a plurality of blocks, and calculating for each block a group of discrete cosine transform (DCT) coefficients for the different types of components;

quantizing the DCT coefficients for each group using

a corresponding quantization table scaled by a gain factor for achieving a target compression factor;

further quantizing the DCT coefficients for each group using the corresponding quantization table scaled by a pre-set factor;

arranging the further quantized DCT coefficients in a vector;

calculating a basic compression factor provided by the quantization table scaled by the pre-set factor as a first function of the vector; and

estimating the gain factor as a second function of the basic compression factor, the second function being determined experimentally according to the target compression factor.

13. A method according to Claim 12, wherein each element comprises a plurality of digital components of different types; and wherein each element of the digital image comprises a luminance component, a first chrominance component, and a second chrominance component.

14. A method according to Claim 12, wherein the vector comprises a zig-zag vector with quantized coefficients representing low frequencies being arranged at a beginning of the vector, and quantized coefficients representing high frequencies being arranged at an end of the vector.

15. A method according to Claim 12, wherein calculating the basic compression factor comprises:

determining a first number of bits required to encode the vector; and

summing the first number of bits with a second number of bits required to encode control values, and dividing the sum by a number of elements of the digital image.

16. A method according to Claim 12, wherein the second function is a quadratic function.

17. A method according to Claim 12, further comprising:

storing a plurality of sets of parameters representing the second function, each set of parameters being associated with a corresponding value of the target compression factor;

selecting an image quality and determining a current value of the target compression factor as a function of the selected image quality; and

reading the parameters associated with the current value of the target compression factor and estimating the gain factor.

18. A method according to Claim 12, wherein the pre-set factor is determined experimentally according to the target compression factor.

19. A method according to Claim 12, further comprising:

storing the DCT coefficients in a memory and concurrently performing the further quantizing of the DCT coefficients for each group using the corresponding quantization table scaled by the pre-set factor, arranging the further quantized DCT coefficients in the vector, calculating

the basic compression factor, and estimating the gain factor; and

reading the DCT coefficients from the memory for performing the quantizing of the DCT coefficients for each group using the corresponding quantization table scaled by the gain factor.

20. A method for compressing a digital image comprising a matrix of elements, each element comprising at least one digital component for representing a pixel, the method comprising:

splitting the digital image into a plurality of blocks, and calculating for each block a group of discrete cosine transform (DCT) coefficients for the different types of components;

quantizing the DCT coefficients for each group using a corresponding quantization table scaled by a gain factor for achieving a target compression factor;

further quantizing the DCT coefficients for each group using the corresponding quantization table scaled by a pre-set factor;

arranging the further quantized DCT coefficients in a vector;

calculating a basic compression factor provided by the quantization table scaled by the pre-set factor as a first function of the vector by

determining a first number of bits required to encode the vector, and

summing the first number of bits with a second number of bits required to encode control values, and dividing the sum by a number of elements of the

digital image; and

estimating the gain factor as a second function of the basic compression factor.

21. A method according to Claim 20, wherein the second function is determined experimentally according to the target compression factor.

22. A method according to Claim 20, wherein each element comprises a plurality of digital components of different types; and wherein each element of the digital image comprises a luminance component, a first chrominance component, and a second chrominance component.

23. A method according to Claim 20, wherein the vector comprises a zig-zag vector with quantized coefficients representing low frequencies being arranged at a beginning of the vector, and quantized coefficients representing high frequencies being arranged at an end of the vector.

24. A method according to Claim 20, wherein the second function is a quadratic function.

25. A method according to Claim 20, further comprising:

storing a plurality of sets of parameters representing the second function, each set of parameters being associated with a corresponding value of the target compression factor;

selecting an image quality and determining a current value of the target compression factor as a function of the

selected image quality; and

reading the parameters associated with the current value of the target compression factor and estimating the gain factor.

26. A method according to Claim 20, wherein the pre-set factor is determined experimentally according to the target compression factor.

27. A method according to Claim 20, further comprising:

storing the DCT coefficients in a memory and concurrently performing the further quantizing of the DCT coefficients for each group using the corresponding quantization table scaled by the pre-set factor, arranging the further quantized DCT coefficients in the vector, calculating the basic compression factor, and estimating the gain factor; and

reading the DCT coefficients from the memory for performing the quantizing of the DCT coefficients for each group using the corresponding quantization table scaled by the gain factor.

28. A device for compressing a digital image comprising a matrix of elements, each element comprising at least one digital component for representing a pixel, the device comprising:

discrete cosine transform (DCT) means for splitting the digital image into a plurality of blocks, and calculating for each block a group of DCT coefficients for the different types of components;

quantization means for

quantizing the DCT coefficients of each group using a corresponding quantization table scaled by a gain factor for achieving a target compression factor, and

further quantizing the DCT coefficients of each group using the corresponding quantization table scaled by a pre-set factor;

arranging means for arranging the further quantized DCT coefficients in a vector;

calculation means for calculating a basic compression factor provided by the quantization table scaled by the pre-set factor as a first function of the vector; and

estimation means for estimating the gain factor as a second function of the basic compression factor, the second function being determined experimentally according to the target compression factor.

29. A device according to Claim 28, wherein each element comprises a plurality of digital components of different types; and wherein each element of the digital image comprises a luminance component, a first chrominance component, and a second chrominance component.

30. A device according to Claim 28, wherein the vector comprises a zig-zag vector with quantized coefficients representing low frequencies being arranged at a beginning of the vector, and quantized coefficients representing high frequencies being arranged at an end of the vector.

31. A device according to Claim 28, wherein said

quantization means quantizes the DCT coefficients for each group using the corresponding quantization table scaled by the gain factor in a first operative condition, and quantizes the DCT coefficients for each group using the corresponding quantization table scaled by the pre-set factor in a second operative condition.

32. A device according to Claim 28, wherein said calculation means determines a first number of bits required to encode the vector, and calculates the basic compression factor summing the first number of bits with a second number of bits required to encode control values, and divides the sum by a number of elements of the digital image.

33. A device according to Claim 32, wherein said DCT means comprises a DCT unit; wherein said quantization means comprises a quantization unit; wherein said arranging means comprises a vector unit; and wherein said estimation means comprises a processor for controlling the compression of the digital image; the device further comprising:

a memory for storing the quantization tables;

a counter for calculating the first number of bits; and

communication means for connecting said DCT unit, said quantization unit, said vector unit, said processor, said memory, and said counter together.

34. A device according to Claim 33, wherein said processor calculates the basic compression factor and estimates the gain factor under control of a program stored in said memory.

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35. A digital still camera comprising:

an image acquisition unit for transmitting light corresponding to an image of scene;

a sensor unit connected to said image acquisition unit for providing a digital image of scene, the digital image comprising a matrix of elements, each element comprising at least one digital component for representing a pixel; and

a control device for compressing the digital image and comprising

a discrete cosine transform (DCT) unit for splitting the digital image into a plurality of blocks, and calculating for each block a group of DCT coefficients for the different types of components;

a quantization unit for

quantizing the DCT coefficients of each group using a corresponding quantization table scaled by a gain factor for achieving a target compression factor, and

further quantizing the DCT coefficients of each group using the corresponding quantization table scaled by a pre-set factor;

a zig-zag unit for arranging the further quantized DCT coefficients in a vector; and

a processor for calculating a basic compression factor provided by the quantization table scaled by the pre-set factor as a first function of the vector, and for estimating the gain factor as a second function of the basic compression factor, the second function being determined experimentally according to the target compression factor.

36. A digital still camera according to Claim 35, wherein each element comprises a plurality of digital components of different types; and wherein each element of the digital image comprises a luminance component, a first chrominance component, and a second chrominance component.

37. A digital still camera according to Claim 35, wherein the vector comprises a zig-zag vector with quantized coefficients representing low frequencies being arranged at a beginning of the vector, and quantized coefficients representing high frequencies being arranged at an end of the vector.

38. A digital still camera according to Claim 35, wherein said quantization unit quantizes the DCT coefficients for each group using the corresponding quantization table scaled by the gain factor in a first operative condition, and quantizes the DCT coefficients for each group using the corresponding quantization table scaled by the pre-set factor in a second operative condition.

39. A digital still camera according to Claim 35, wherein said processor determines a first number of bits required to encode the vector, and calculates the basic compression factor summing the first number of bits with a second number of bits required to encode control values, and divides the sum by a number of elements of the digital image.

40. A digital still camera according to Claim 39, further comprising:

a memory for storing the quantization tables;

a counter for calculating the first number of bits; and

a bus for connecting said DCT unit, said quantization unit, said vector unit, said processor, said memory, and said counter together.

41. A digital still camera according to Claim 40, wherein said processor calculates the basic compression factor and estimates the gain factor under control of a program stored in said memory.

REMARKS

It is believed that all of the claims are patentable over the prior art. For better readability and the Examiner's convenience, the newly submitted claims differ from the translated counterpart claims which are being canceled. The newly submitted claims do not represent changes or amendments that narrow the claim scope for any reason related to the statutory requirements for patentability. Accordingly, after the Examiner completes a thorough examination and finds the claims patentable, a Notice of Allowance is respectfully requested in due course. Should the Examiner determine any minor informalities that need to be addressed, he is encouraged to contact the undersigned attorney at the telephone number below.

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Respectfully submitted,

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